Saskatchewan
Agriculture, Food
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AGRICULTURE DEVELOPMENT FUND

FINAL REPORT

20010395

DEVELOPING CHICKPEA AND FIELD PEA FOR SASKATCHEWAN

Funded by:
The Agriculture Development Fund

March 2003
Prepared by: University of Saskatchewan

103-04313/

Final Report

ADF Project 20010395 Res. 63AD

DEVELOPMENT OF FIELD PEA AND CHICKPEA FOR SASKATCHEWAN

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March, 2003

ABSTRACT

Use pattern for fall application of Pursuit on chickpea was confirmed and refined. Two new compounds (sulfentrazone and isoxaflutole) were identified as potential new herbicides for chickpea. Increased water volume and zinc additives did not reduce injury to chickpea from Sencor. The pea and chickpea development program developed six pea varieties (five yellow, one green) and two chickpea varieties (one desi, one kabuli). Progress was made in understanding the biology and pathology of Aschochyta on chickpea. Field trials indicated that increasing water volume improved the efficacy of fungicides but did not result in increased crop yield. Quadris was more effective than other fungicides for control of Ascochyta blight on chickpea.

EXECUTIVE SUMMARY

Weed control studies confirmed that fall application of Pursuit provided satisfactory control of many broad-leaved weed species and was safer on the chickpea crop than pre-emergence applications in the spring. Other trials identified sulfentrazone and isoxaflutole as promising candidates for weed control in chickpea. Both pea an chickpea were not adversely affected when Buctril M, MCPA, Pardner or Viper were applied prior to crop emergence for early season weed control. Increasing the water volume or use of a zinc containing adjuvant did not reduce chickpea injury from Sencor herbicide. Five yellow cotyledon and one green cotyledon pea varieties were released or recommended for registration during the year. In addition, two chickpea varieties were released, CDC Cabri (desi type) and CDC Frontier (kabuli type). Correlation analysis of disease data with yield and plant anatomical characters revealed significant negative correlations between yield and disease development, and significant positive correlations between disease and lodging in field pea. Analysis of lignin, fiber and cellulose revealed that the percentage of lignin and fiber content in pea stems was negatively correlated with lodging and disease severity on whole plants. Cellulose was also negatively correlated with disease severity on whole plants. In chickpea fungicide trials to optimize carrier volume and droplet size, an increase in carrier volume significantly reduced disease severity with all four fungicides due to better spray coverage of plants, but there were no significant differences in blight control and yield derived from using different spray droplet sizes. Fungicides also differed in their effectiveness on ascochyta blight control with Headline being relatively the best followed by Quadris, BAS 510F and Bravo 500. Results of other trials in chickpea indicate that ascospores have contributed to the spread of the ascochyta fungus and most likely to the creation of a diverse range of isolate virulence, which will have a significant impact on the management of ascochyta blight.

TECHNICAL REPORT

I. WEED CONTROL

Objectives:

1. To develop cost effective pulse crop weed control measures for Saskatchewan farmers consistent with improving the sustainability of agriculture in Sasakatchewan.
2. To support the diversification of Saskatchewan crop production through the development of suitable herbicide treatments for pulse crops.
3. To assist Saskatchewan Agriculture and Food in the development of provincial weed control recommendations.

Experimental Procedures:

Replicated, small plot field trials are conducted at the Kernen Crop Research Farm, the Pulse Growers Land and the Goodale Research Farm using standard weed control research methodology. Agricultural Research Manager software developed by Gylling Data Management Inc., Brookings, SD is used to create experimental protocols, field plot plans and herbicide mixing sheets. It is also used to summarize and analyse data and produce reports that are submitted to appropriate SAFRR staff, herbicide manufacturers/distributors and other interested parties. Some of the data are used to support submissions for product registrations under the Minor Use of Pesticides Registration Program.

Ten experiments involving 78 individual treatments were conducted on chickpea during the 2002 growing season. Two experiments (17 treatments) were conducted on field pea. The 2002 growing season was extremely difficult and was characterized by extreme drought, a cool spring, very hot July, heavy grasshopper infestation and a prolonged, damp harvest season. All of this took its toll on many research trials. Consequently, several trials were abandoned and much of the data collected from those trial that were carried through to completion is of poorer quality than we would like.

Results and Discussion:

A. Fall applied weed control in Desi Chickpea.

We continued to evaluate low rates of Pursuit applied to undisturbed stubble in the fall for the control of broad-leaved weeds in chickpea. Rates of application in the range of 33-40% of rates recommended for in-crop application to field pea appear to provide consistent control of several broad-leaved weed species and result in only slight injury to the crop Both weed control and crop safety are better than with applications made post-emergent to the crop. In 2002, these treatments resulted in higher chickpea yield than did the current commercial herbicide standard. This work was carried out in collaboration with Agriculture and Agri-food Canada scientists at Scott, SK and Swift Current, SK. Results have been presented at a number of scientific and producer oriented conferences

(see outputs). Efforts to convince the manufacturer of this product were continued but the prospect of this actually happening are dim.

B. Spartan (sulfentrazone) for weed Control in Chickpea.

Spartan is a herbicide used for weed control in legume and pulse crops and sunflower in the USA. We have been testing it for use on chickpea in Saskatchewan.

(a) Sulfentrazone for Use on Desi Chickpea.

All rates of sulfentrazone were safe on Desi Chickpea. Green foxtail was controlled with sulfentrazone at 420 gai/ha and with the Edge and Pursuit treatments. Stinkweed was suppressed with sulfentrazone 420 gai/ha and controlled with the Edge + Sencor and Pursuit treatments. Redroot pigweed was controlled with sulfentrazone at 210 and 420 gai/ha and the Edge + Sencor and Pursuit treatments.

(b) Sulfentrazone for Weed Control in Desi Chickpea.

Standard post-emergent applications of currently recommended herbicides were compared to pre-plant incorporated and pre-emergence applications of sulfentrazone. Pre-plant incorporated sulfentrazone was slightly better than pre-emerge treatments. Desi chickpea was tolerant to all rates of sulfentarazone. Any yield reduction was due to weed competition. Sufentrazone at 420 gai/ha reduced green foxtail, wild mustard, and stinkweed populations but not enough to be listed as suppression. Redroot pigweed , lambs quarters and wild buckwheat were controlled with all rates of sulfentrazone.

(c) Sulfentrazone for Use on Kabuli Chickpea.

All rates of sulfentrazone were safe on Kabuli Chickpea. Green foxtail was injured with sulfentrazone but not enough to be classified as suppression and was controlled with the Edge/Sencor treatment and suppressed with the Pursuit treatment. Sulfrentrazone at 210 and 420 gai/ha injured the wild mustard but not enough to be classified as suppression. Only Pursuit controlled the wild mustard. Sulfentrazone at 420 gai/ha gave suppression of redroot pigweed. Only Pursuit controlled redroot pigweed.

(d) Improving Performance of Spartan (sulfentrazone) Herbicide in Zero-Till Seeded Desi chickpea.

Desi chickpea was tolerant to sulfentrazone at all rates fall and spring applied, both incorporated and surface applied. There was good control of cleavers, Russian thistle, redroot pigweed, lamb's quarters and wild buckwheat with all treatments that included sulfentrazone. 300 gai/ha of sulfentrazone controlled stinkweed and green foxtail. 210 gai/ha had some activity on stinkweed but not enough for control. The surface applied 210 gai/ha rate suppressed green foxtail. Wild mustard was not controlled by sulfentrazone.

C. Tolerance of Desi Chickpea to Post-seeding Roundup tank-mixes.
Many zero-till producers want to mix a herbicide for broad-leaved weeds with Roundup for application to pulse crop fields prior to emergence of the crop. However, many of these products have the potential to remain active in the soil for a short period of time and may injure the emerging pulse crop. We tested Buctril M, MCPA amine, Pardner and Viper in combination with Roundup to assess their safety on desi chickpea. Desi chickpea was tolerant to all the pre-emerge treatments. There was no significant difference in visual injury, plant count, biomass or yield between any of the treatments and the Roundup Transorb treatment. Plant stand, biomass and seed yield are very low due to extreme drought throughout the growing season.

D. Isoxaflutole for Use in Chickpea.

(a) Tolerance of Desi and Kabuli Chickpea to Pre-emergence Isoxaflutole.
Both Desi and Kabuli chickpea are tolerant to all rates of isoxaflutole that were applied. Seed yield is very low due to drought.

(b) Isoxaflutole for Weed control in Desi Chickpea.
Desi chickpea was tolerant to all rates of Isoxaflutole. The herbicide gave some suppression of green foxtail at the 79 and 105 gai/ha rates, and control of green foxtail at the 158 and 210 gai/ha rates. Green foxtail control was best with Poast Ultra. Wild mustard, stinkweed and lamb's quarters were controlled with isoxaflutole rates as low as 40 gai/ha. Cleavers were suppressed with 79 gai/ha and controlled with rates of 105, 158 and 210 g ai/ha. Wild buckwheat was not controlled with isoxaflutole.

E. Reducing Sencor (metribuzin) and Pursuit (imazethapyr) Injury to Chickpea.

(a) Herbicide Timing and Spray Solution Volume.
Early application of post-emergence herbicides was essential in reducing phytotoxicity to chickpea. Applying Sencor at the 3-5 node stage of the crop resulted in chickpea yields of 102 % of the untreated check (UTC). Delaying the Sencor application until the 8-10 node stage of the crop resulted in seed yield that was only 81% of the UTC. Early application of Pursuit increased crop yield to 118% of the UTC while late application resulted in a yield of only 74% of the UTC. Varying the spray solution volume from 50 to 100 to 150 L/ha did not have any effect on the extent of crop damage observed.

(b) Zinc as a Safener for Sencor on Chickpea.
Two zinc containing products (Micro Plus 10% Zinc and ProSol Zinc 25%) have recently been promoted to farmers as spray adjuvants that can reduce the amount of crop injury from Sencor on chickpea. In our replicated trials, neither of these products had any effect on the level of crop injury observed. These experiments form the basis of a senior undergraduate thesis that will be submitted to the department of Plant Sciences this spring.

F. Weed Control in Field Pea.

(a) Tolerance of field Pea to Post-seeding Roundup Tank-mixes.

This experiment was similar to the one described above for chickpea. Field pea was tolerant to all pre-emerge treatments as there was no significant differences in plant stand, biomass or yield when compared to the Roundup Transorb treatment.

(b) Field Pea Plant-back Timing After 2,4-D Application.

Farmers often wish to apply 2,4-D in the spring prior to seeding a crop in order to control winter annual and early spring emerging weeds. However, 2,4-D residues in the soil may injure sensitive crops such as pulse crops. This experiment was conducted to determine if field pea can be safely planted following a spring application of 2,4-D. There was some injury on the June 21 rating and a 20 % reduction in plant stand. However, there was no reduction in crop biomass or yield compared to the untreated check. On the basis of this trial, we can conclude that field pea is tolerant to pre-plant 2,4-D.

Outputs:

The information generated is of direct use to pea and chickpea producers and indirectly to extension personnel, herbicide manufacturers, industry agronomists and other farm advisors. The results of these trials are transmitted directly to SAFRR and the industry via the annual report on weed control research at the Crop Development Centre which will be published and distributed by March 31, 2003.

More specifically, aspects of this work (primarily the work on fall application of Pursuit) has been transmitted in the following ways:

Scientific poster presented at the annual meeting of the Canadian Weed Science Society, Saskatoon, SK, November 2002 (received best poster award) and to be presented at the Western Society of Weed Science, Kauai, HI, March 2003.

Extension oriented poster, Broadleaf weed control in chickpea and lentil with fall application of Pursuit (imazethapyr). K.L. Sapsford, F.A. Holm, E.N. Johnson and Y. Gan.presented at:

- Pulse Days, 2003. Saskatoon, SK, January 2003. Abstract. P92, Proceedings, Pulse Days 2003, Saskatoon, SK. January 6-7, 2003.
- Soils and Crops Workshop, University of Saskatchewan, February 18 & 19, 2003.
- Sask. Soil Conservation Association annual meeting, Saskatoon, SK, February 20 & 21, 2003.

II. FIELD PEA BREEDING

T. Warkentin, A. Vandenberg, S. Banniza, M. Lulsdorf, A. Tullu, and B. Tar'an

Objectives

The primary objective is the development of early maturing, high yielding field pea cultivars with resistance to powdery mildew, improved resistance to mycosphaerella blight and lodging, and with acceptable quality for export and domestic food and feed markets.

Experimental Procedures

On average, 250 new populations are generated each year during the course of three crossing cycles (summer, fall and winter). If possible, gamete selection is used to screen pollen donors for single gene traits. The F2-derived family method is used. Visual selection for seed quality traits is conducted in each generation. Selection for powdery mildew resistance is conducted in the F1 generation of complex crosses or the F2 generation of single crosses. Approximately 10,000-15,000 F2-derived F3 families are evaluated each year. Approximately 2000 of these are advanced to F4 preliminary yield trials with one replicate at each of two locations, based on selection for plant type, lodging resistance, maturity, and mycosphaerella blight resistance. Approximately 10% of the F4 generation is advanced to F5 generation following selection based on yield, lodging resistance, and maturity. F5 advanced lines are evaluated in two replicate yield trials at 4-5 locations. The 32 most promising of these are tested in an F6 Elite test at 6-10 locations. The best lines are entered into the Field Pea Cooperative Registration Test. Standard 4-row yield plots with rows 4 m long and 30 cm apart are used at most locations. Pre-breeder seed development is initiated concurrent with Elite testing. Single plants are selected from the best performing Elite lines. These are grown as microplots concurrent with first year Co-operative Testing, and as long plots concurrent with second year Co-operative Testing. Breeder seed of new varieties is typically bulked after long plot evaluation.

Results and Discussion

The powdery mildew resistant, yellow cotyledon cultivars CDC Mozart, CDC Handel, and CDC Minuet are currently among the top yielding cultivars (110%, 106%, and 108% of cv. Alfetta, respectively (mean of the two production regions)) in Saskatchewan based on regional trial results. The yellow cotyledon lines CDC 0007, CDC 0009, and SB2000-2 were supported for registration in February 2002 by the Prairie Registration Recommending Committee for Grain (PRRCG). All are powdery mildew resistant with improved yield compared to the yellow check cultivars. CDC 0007 and CDC 0009 also

have similar lodging resistance compared to the most resistant check. SB2000-2 was co-developed with Alberta Agriculture Food & Rural Development. SB2000-2 was registered as "Cutlass" in 2003, CDC 0007 is in the process of being registered. Both will be released to Select Seed growers in Saskatchewan and Alberta in spring 2003. CDC 0009 will probably be released in spring 2004.

CDC Striker (previously CDC 0001) was supported for registration in 2002 by the PRRCG, and subsequently registered and released in 2002. It has improved lodging resistance and seed quality traits compared to the green check cultivar Nitouche. CDC Striker is among the top yielding green cotyledon cultivars (99% of cv. Alfetta (mean of the two production regions)) in Saskatchewan, based on regional trial results. Similarly,

CDC Montero, a powdery mildew resistant green cotyledon cultivar is among the top yielding green cotyledon cultivars (97% of cv. Alfetta (mean of the two production regions)) in Saskatchewan, based on regional trial results. CDC Verdi is one of the top yielding green pea cultivars in the southern region, based on Saskatchewan regional trials in 1999-2001. It has relatively late maturity and, thus, is less competitive in the northern region.

CDC Sonata, a yellow cotyledon forage cultivar with normal leaf type, large biomass, and powdery mildew resistance, and CDC Acer, a maple pea cultivar with powdery mildew resistance and small seed size performed well in the 2001 and 2002 Saskatchewan regional trials.

Support for registration for two yellow cotyledon varieties will be requested in February 2003. CDC0102 and CDC0103 were among the top yielding lines in the 2001-2002 Field Pea Co-operative Tests.

Five lines (three yellow and two green cotyledon) will being evaluated in the 2nd year of the Field Pea Co-operative Test in 2003. Five lines (four yellow and one green cotyledon) will be evaluated in 1st year testing. All of the above field pea varieties are being distributed by the Saskatchewan Pulse Growers.

III – Chickpea Breeding

T. Warkentin, A. Vandenberg, S. Banniza, M. Lulsdorf, A. Tullu, and B. Tar'an

Objectives

The primary objective is the development of early maturing, high yielding chickpea cultivars with improved ascochyta blight resistance and acceptable quality for desi and kabuli markets.

Experimental Procedures:

Approximately 150 new populations are generated each year during the course of three crossing cycles (summer, fall and winter). If possible, gamete selection is used to screen pollen donors for single gene traits. The F2-derived family method is used. Visual

selection for seed quality traits is conducted in each generation. Approximately 10,000 F2-derived F3 families are evaluated each year. Approximately 2000 of these are advanced to F4 preliminary yield trials with one replicate at each of two locations, based on selection for plant type, maturity, and ascochyta blight resistance. Approximately 10% of the F4 generation is advanced to two replicate F5 yield trials at three locations following selection based on yield, ascochyta blight resistance, and maturity. Approximtely 30 lines are evaluated in F6 elite yield tests at six to eight locations. The best lines are then advanced to regional trials. Plot technique and breeder seed development is similar to that used in field pea breeding.

Results and Discussion

Desi market class. CDC Desiray had similar yield to the check variety Myles in Saskatchewan regional trials (1997-2002). Its plumper seed shape and lighter seed coat color than Myles are advantageous in most markets. CDC Anna had a 9% yield advantage compared to Myles in Saskatchewan regional trials (1998-2002). CDC Nika has significantly larger seed size than Myles with similar yield in Saskatchewan regional trials (1998-2002). CDC Desiray and Myles have similar days to maturity, while CDC Anna and CDC Nika are slightly later. All four cultivars have similar (fair) ascochtya blight resistance.

CDC Cabri (formerly 92073-40) will be released to Select Seed growers in Saskatchewan and Alberta in spring 2003. It has had a 10% yield advantage compared to Myles in Saskatchewan regional trials (1999-2002), with slightly earlier time to flowering, similar maturity and ascochyta blight reaction, and medium-large seed size.

Kabuli market class. CDC Yuma had a 14% yield advantage over the kabuli check cultivar Sanford in Saskatchewan regional trials (1996-2002). This yield advantage is primarily attributed to better ascochyta blight resistance (poor vs. very poor). CDC Xena had a 25% yield advantage over Sanford in Saskatchewan regional trials (1997-2002). This yield advantage is primarily attributed to its earlier maturity. CDC Diva had a 10% yield advantage over Sanford, with larger seed size and earlier maturity, in Saskatchewan regional trials (1999-2002). CDC ChiChi was released to Select seed growers in 2002. It had a 17% yield advantage over Sanford with earlier maturity and improved ascochyta blight resistance (poor vs. very poor), and slightly whiter seed coat color in Saskatchewan regional trials (1999-2002). CDC Yuma, CDC Xena, CDC Diva, CDC ChiChi and Sanford are all large seed size cultivars (8-10 mm). The small seed size (7 mm) cultivar CDC Chico had a 41% yield advantage over Sanford in Saskatchewan regional trials (1996-2002). This yield advantage is primarily attributed to better ascochyta blight resistance (poor vs. very poor) and earlier maturity.

CDC Frontier (formerly 95NN-29) will be released to Select Seed growers in Saskatchewan and Alberta in spring 2003. It has had a substantial yield advantage compared to Sanford in Saskatchewan regional trials (2000-2002), with medium maturity and medium seed size (8 mm). CDC Frontier has fair ascochyta blight reaction, similar to that of the small kabuli check Amit, and similar to the desi cultivars mentioned above.

Outputs

Public property

a) Concepts proceeding to further work

-Entry or advancement of 20 chickpea lines into the 2002 Chickpea Regional Trial in Saskatchewan and Alberta.
-Yield trial evaluation of 36 F6 lines, 192 F5 lines, and 2100 F4 lines in 2002.
-Advancement of 160 F2-F3 populations in 2002.
-155 new populations developed in 2002.

b) Publications

Pu-hai Liu, Yantai Gan, Tom Warkentin, and Cal McDonald. 2003. Morphological plasticity of chickpea in a semiarid environment. Crop Sci. 43:426-429.

Chowdhury, M., Vandenberg, A., and Warkentin, T.D. (2002). Cultivar identification and genetic relationship among selected breeding lines and cultivars in chickpea (*Cicer arietinum* L.). Euphytica 127:317-325.

Warkentin, T., and Vandenberg, A. (2003) Future priorities and research strategies for chickpea improvement in Canada. Chickpea Scientists Meet. ICRISAT, Patencheru, India.

Chongo, G., Banniza, S., Gan, Y., Wolf, T., and Warkentin, T. (2003) Fungicides application timing, sequencing and tank mixes for controlling blight in chickpea. Soils and Crops 2002. Extension Division, University of Saskatchewan (Saskatoon).

Anbessa, Y., Warkentin, T., Vandenberg, A., and Ball, R. (2003) Early flowering and short internode length as components of early maturity in chickpea. (poster) Pulse Days 2003, Saskatchewan Pulse Growers (Saskatoon).

Chongo, G., Banniza, S., Gan, Y., Wolf, T. and Warkentin, T. (2003) Fungicide application timing, sequencing and tank mixing for controlling blight in chickpea. (poster) Pulse Days 2003, Saskatchewan Pulse Growers (Saskatoon).

Lulsdorf, M., Ahmad, F., Banniza, S., Warkentin, T., and Vandenberg, A. (2003) Development of new and effective sources of ascochyta blight resistance in chickpea. (poster). Pulse Days 2003, Saskatchewan Pulse Growers (Saskatoon).

Lulsdorf, M., Croser, J., Dament, T., Allen, K., Warkentin, T., and Vandenberg, A. (2003) Development of doubled haploid technology for chickpea. (poster). Pulse Days 2003, Saskatchewan Pulse Growers (Saskatoon).

Anbessa, Y., Warkentin, T., Vandenberg, A., and Ball, R. (2002) Associations of maturity duration with grain yield and yield related traits under diverse environments in

chickpea. (poster) H-H Muendel (ed.), 4th Canadian Pulse Research Workshop (Edmonton).

Chongo, G., Banniza, S., and Warkentin, T. (2002) Performance of various chickpea cultivars under different levels of ascochyta blight. H-H Muendel (ed.), 4th Canadian Pulse Research Workshop (Edmonton).

Gan, Y., Warkentin, T.D., Johnston, A., and McDonald, C. (2002) Chickpea pod infertility: a potential of improving seed yield. Soils and Crops 2002. Extension Division, University of Saskatchewan (Saskatoon).

c) Presentations

See Field Pea Breeding section

d) Know-how ready for distribution
e) Extension materials

Commercializable property

a) Concepts requiring further development
b) Concepts proceeding to patent
c) Patents granted
d) Varieties registered/ released
   - Released to Select seed growers in 2003

   CDC Frontier kabuli chickpea. A. Vandenberg, T. Warkentin, S. Banniza and A. Slinkard

   CDC Cabri desi chickpea. A. Vandenberg, T. Warkentin, S. Banniza and A. Slinkard

IV. PULSE CROP PATHOLOGY

Pea Pathology

Objectives and Description:

The primary objective of the pea pathology program is to support breeding efforts in the pea breeding program to increase levels of resistance to mycosphaerella blight, the most important disease in this crop. In addition to screening of disease nurseries in F_4 and later generations, research (funded through the Saskatchewan Agricultural Development Fund) has been conducted to investigate the relationship between lodging, mycosphaerella blight and the degree of lignification in pea stems. The objective was to elucidate the interrelationship between lodging and mycosphaerella blight, and to investigate whether stem anatomical characters can aid in the selection of lodging and disease resistant material.

Experimental Procedures:
Two experiments were initiated in May 2002, one at Saskatoon (rain fed) and one at Outlook under irrigation. At both sites, 20 varieties (Integra, Keoma, AC Melfort, Carneval, CDC Peko, AC Tamor, Carrera, Espace, Nitouche, Radley, Courier, 203 PMR-16, Grande, Alfetta, CDC Mozart, Eclipse, Miami, CDC 0001, CDC 0109, Eiffel) were seeded in plots of 2.44 m x 3.66 m with a row spacing of 0.30 m in three replicates (RCBD). During the growing season, plant height, number of nodes, length and diameter of the internodes between nodes two and three, five and six, and eight and nine, severity of *Mycosphaerella* infection and lodging severity were measured at approximately 10 day intervals, starting from 27 June.
Pieces of pea stems were preserved for laboratory analysis of stem sections. The laboratory work initially concentrated on the varieties Keoma, Carneval and Integra (sections from Saskatoon in 2000 and from Outlook in 2001). Stem sections of these varieties were photographed under microscope and the area of various tissue types was determined.
Acid detergent fiber (ADF), acid detergent lignin (ADL) and cellulose were determined in samples of 0.5 g of air- dried, ground pea stems in the ANKOM FIBER ANALYZER using standard protocols.

Results and Discussion:
At Saskatoon, severe drought conditions during most of the growing season resulted in pea plants shorter than average. Disease development was minimal and no differences were observed between varieties. Differences were observed in lodging and more lodging was correlated with higher disease ratings. Differences were also observed in several stem anatomical measurements. At Outlook, plant development was vigorous under irrigation and significant differences were observed in susceptibility to the pathogen and to lodging among the 20 varieties in the test. Trends were similar as in 2001 and AC Tamor was among the varieties with highest disease rating and highest lodging score. Correlation analysis of disease data with yield and plant anatomical characters revealed significant negative correlations between yield and disease development, and significant

positive correlations between disease and lodging. Analysis of lignin, fiber and cellulose revealed that the percentage of lignin and fiber content in pea stems was negatively correlated with lodging and disease severity on whole plants. Cellulose was also negatively correlated with disease severity on whole plants.

Chickpea Pathology

Objectives and description:
The main focus of plant pathology research in chickpea has been the development of disease management strategies (funded through the Saskatchewan Agricultural Development Fund and the Saskatchewan Pulse Growers Association) and the study of population dynamics of *Ascochyta rabiei* (funded through the Western Grains Research Foundation).

Experimental procedures:
Two field trials were conducted to evaluate fungicide application strategies for ground spray methods to help optimize carrier volumes and droplet sizes. The first trial compared 3 water volumes (100, 200, and 300 L/ha) sprayed on three cultivars; Myles (fern leaf type - Desi), CDC Yuma (fern leaf type - Kabuli) and Sanford (unifoliate leaf type-Kabuli) to control ascochyta blight. The trials were conducted at Saskatoon (University of Saskatchewan, Kernen Research Farm), and at Outlook (Canada-Saskatchewan Irrigation Diversification Centre). Fungicide treatments included a combination of Bravo 500 (chlorothalonil, Syngenta) followed by Quadris and two applications of each of the following fungicides, Quadris (azoxystrobin, Syngenta), Headline (pyrachlostrobin, BASF), BAS510F (boscalid, BASF). An untreated control was also included. Disease development was initiated by spreading naturally infested stubble in each plot at Outlook and a mixture of stubble and artificially produced seed-borne inoculum at Kernen. The experimental design was a factorial randomized complete block design with 4 replicates. Fungicides were applied with standard flat fan nozzles at 275 kPa. The first fungicide application was done at the first sign of symptoms followed by a second application 10-14 days later. Ascochyta blight was rated at each fungicide spray date and again 3 times at two week intervals after the last fungicide application. Seed yield and 1000 seed weight were also assessed following harvest. A second trial was designed to compare 3 nozzle types representing 3 different spray qualities and was conducted at Saskatoon (U of S) and Outlook. The cultivars used were Myles (desi) fern leaf type and Sanford (kabuli) unifoliate leaf type each producing a different canopy architecture. Fungicides included Bravo 500, Quadris and Headline. The three spray droplet sizes were obtained by using three different nozzle types which included Lurmark Twin Cap (delivers a fine spray from two XR8001 tips spraying 30° forward and backward from the vertical), standard nozzle (XR8002, delivers medium spray) and venturi nozzles, (Air Bubble Jet 11002, delivers very coarse spray). Disease initiation and the experimental design for each cultivar were as described above and fungicides were applied in 200 L/ha water volume. Disease rating, and all other agronomic data and data analysis were performed as described above.

Further fungicide trials were conducted in commercial fields aimed at determining application timing for controlling blight in chickpea using cultivar Myles (desi) at Elrose and CDC Chico (kabuli) at Zealandia. Seeding was May 10 at both sites. The fungicides used included Bravo 500 (chlorothalonil, Syngenta), Quadris (azoxystrobin, Syngenta), Headline (pyraclostrobin, BASF) and BAS510 F (boscalid, BASF). The design was a randomized complete block design (RCBD) with four replicates.
A second set of fungicide trials were conducted at Saskatoon (Kernen Research Farm, University of Saskatchewan) and at Swift Current (AAFC-SPARC) using CDC Yuma (kabuli) and Myles (desi) Various fungicide rotation and spray dates as well as a per calendar fungicide applications were compared. Fungicides included Dithane, Bravo 500, Quadris, Headline and BAS510 F and a Bravo 500 plus Quadris tank mix treatment. At Saskatoon a RCBD with four replicates was used for each cultivar. A split-block design with cultivar as main-plots and fungicides as sub-plot factors was used at Swift Current.
In addition to field trials, a growth chamber study was conducted under controlled conditions using cultivars CDC Yuma and Myles, which also included inoculated and non-inoculated checks. Seeding was done in 4" pots with 4 seeds per pot. Pots were kept at 20/16°C (day/night) temperature and 16 h photoperiod arranged in a RCBD with four replicates. Plants were artificially inoculated with a conidial spore suspension of 200 000 spores/mL at 4 weeks after seeding which was increased at subsequent inoculations. This trial evaluated fungicides closely on their protection of different plant parts including stems, leaves and pods.

In 2002 approximately 200 isolates of *A. rabiei* were collected bringing the total to about 300 isolates since 2001. These isolates are being used in studies to compare virulence of isolates on 8 differential chickpea cultivars/lines and in comparisons using random amplified polymorphic DNA. So far 40 isolates have been tested for virulence and mycelia for DNA analysis has been obtained from 75% of the isolates. Due to insufficient seed from two original deferential chickpea cultivars/lines and severe difficulties in increasing seed, we had to substitute these two lines with two commercial cultivars. Tests are currently conducted to evaluate potential differences between original and replacement cultivars. In the host range study, 11 crop species normally rotated with chickpea in Saskatchewan, were tested under controlled conditions using *A. rabiei*, *Colletotrichum truncatum*, *A. lentis* and *Mycosphorella pinodes* (the last three cause anthracnose, on lentil and ascochyta blight on lentil and pea, respectively). Only *A. rabiei* was further tested under field conditions. Crosses were made between field isolates and MAT 1 and MAT 2 isolates to investigate he distribution of the two mating types in Saskatchewan's chickpea fields. The formation of air-borne ascospores in the field was monitored by collecting chickpea stubble and incubating it under laboratory conditions, and by using spore traps placed in five fields in central and southern Saskatchewan.,. In addition, spore traps were placed in five fields in central and southern Saskatchewan to determine the peak time for ascospore release.

Results and discussion:
In 2002, spring was cool and dry and the summer was characterized by drought leading to heat stress in many parts of central Saskatchewan. Swift Current where one trial was located, received above average rainfall. Due to drought, ascochyta blight levels were

low and plants died prematurely at Elrose and Zealandia and plots were not harvested. The data from Saskatoon is not included because of spray contamination and also very poor yields due to low plant density. Under growth chamber conditions, disease levels were low in all treatments partly due to fungicides, but also due to lack of conditions that favour conidial dispersal in the field such as rain splash. Swift Current received above average rainfall and plant stand was good. Trials at Swift Current showed that cv. Myles was less diseased than cv. CDC Yuma. Differences in the level of ascochyta blight control were observed among fungicide treatments, which were influenced by cultivar type. Four and five sprays to cv. CDC Yuma and at least two sprays to cv. Myles reduced blight to less than 50% and increased yields by up to 351% and 84%, respectively.

In the trials to optimize carrier volume and droplet size, an increase in carrier volume significantly reduced disease severity with all four fungicides due to better spray coverage of plants, but there were no significant differences in blight control and yield derived from using different spray droplet sizes. In these trials, late cool wet weather also affected chickpea crops negatively, through delayed maturity, poor pod fill and subsequently contributed to the low seed yields obtained at both locations especially from the kabuli cultivars. Plants in of cv. Sanford in all the spray droplet size treatments completely died or suffered close to or 100% yield loss one month prior to harvest. This was not the case with cv. Myles which received similar treatments, but produced reasonable yields. This suggests that two applications are not adequate to protect unifoliate kabuli cultivars from severe losses under favourable conditions for disease development. Fungicides also differed in their effectiveness on ascochyta blight control with Headline being relatively the best followed by Quadris, BAS 510F and Bravo 500. The 200 L/ha water volume appears to provide adequate spray coverage which is better than 100 L/ha, but similar to 300 L/ha; spray droplet size or the type of nozzle produced similar results. Attention to cultivar selection and spray volume should be important factors to chickpea growers if they are to reduce costs and maximize returns.

In host range studies, *A. rabiei* was isolated from 10 of 11 crops under controlled conditions. Although *A. rabiei* infected 10 of the 11 species other than chickpea, lesions were very small and non-sporulating. Under field conditions, *A. rabiei* was isolated from field pea only. Therefore, the role of these crops in providing sufficient inoculum to chickpea would seem to be minimal. The other pathogens do not appear to have a significant impact on chickpea. In crosses of 72 field isolates with MAT-1 and MAT-2 tester isolates, the two mating types appeared in equal frequencies in the field and on the same plant or lesion. After incubation, ascospores were released from chickpea stubble collected from 2 of 10 fields surveyed. Preliminary result from spore traps show that the release of ascospores started in May, peaked in June and was substantially reduced by July. These observations indicate that ascospores have contributed to the spread of the ascochyta fungus and most likely to the creation of a diverse range of isolate virulence, which will have a significant impact on the management of ascochyta blight.

OUTPUTS
Papers in Refereed Journals:

Banniza, S., and A. Vandneberg (2003): The influence of plant injury on the development of *Mycospaherella pinodes* in dry field pea. Accepted for publication in Canadian Journal of Plant Pathology, January 15, 2003.

Papers in Conference Proceedings:

Chongo, G., Banniza, S., Warkentin, T., Gan, Y., and T. Wolf (2002): Performance of various chickpea cultivars under different levels of ascochyta blight. Proceedings of the Canadian Pulse Research Workshop, Edmonton, December 8 – 10, 2002, pp.172-176

Hashemi, P., Banniza, S., i Davis, A., Warkentin, T., and Vandenberg, A. (2002): Relationships between lodging, stem anatomy, stem lignification and reaction to mycosphaerella blight in field pea. Proceedings of the Canadian Pulse Research Workshop, Edmonton, December 8 – 10, 2002, pp. 177-182.

Diederichsen, A., Banniza, S., Buchwaldt, L., Vandenberg, A., Warkentin, T., and K.W. Richards (2002): Characterization, Evaluation and Acquisition of Pulse Germplasm by Plant Gene Resources of Canada. Proceedings of the Canadian Pulse Research Workshop, Edmonton, December 8 – 10, 2002, pp. 207-210.

Vijayan, P., Taran, B., Warkentin, T., Banniza, S., and A. Vandenberg (2002): Plant genomics in lentil breeding: Development of a cDNA based rapid screening method for Ascochyta Blight Resistance in Lentil. Proceedings of the Canadian Pulse Research Workshop, Edmonton, December 8 – 10, 2002, pp.216-218.

Tar'an, B., Buchwaldt, L., Banniza, S., Tullu, A., Warkentin, T., and A. Vandenberg (2002): Pyramiding of Genes for Resistance to Ascochyta Blight and Anthracnose in Lentil. Proceedings of the Canadian Pulse Research Workshop, Edmonton, December 8 – 10, 2002, pp. 219-224.

Chongo, G., and Banniza, S. (2002): Survival and viability of *Ascochyta rabiei* on infested chickpea stubble on and below the soil surface in Saskatchewan. Proceedings of the Canadian Pulse Research Workshop, Edmonton, December 8 – 10, 2002, pp. 266-270.

Kuchuran, M., Banniza, S., and A. Vandenberg (2002): Evaluation of Lentil Germplasm for Disease Resistance to *Botrytis* spp. Proceedings of the Canadian Pulse Research Workshop, Edmonton, December 8 – 10, 2002, pp. 293-296.

Poster and poster abstracts:

Ta'ran, B., Bett, K., Banniza, S., Warkentin, T., and A. Vandenberg (2003): Rapid Conversion of locally adapted bean varieties to common bacterial blight resistance. [Poster Abstract] Pulse Days 2003, Saskatoon, January 6-7, 2003, p. 69

Tullu, A., Luisldorf, M., Barlow, B., Breitkreuz, C., McHale, S., Banniza, Buchwaldt, L., Saker, A., Ta'ran, B., Warkentin, T. and A. Vandenberg (2003): Revisiting strategies for breeding anthracnose resistance in lentil: The case study with wild lentil. [Poster Abstract] Pulse Days 2003, Saskatoon, January 6-7, 2003, p. 70

Kuchuran, M., Banniza, S.and A. Vandenberg (2002): Evaluation of lentil varieties for resistance to botrytis gray mold. [Poster Abstract] Pulse Days 2003, Saskatoon, January 6-7, 2003, p. 89

Luilsdorf, M., Ahmad, F., Banniza, S., Warkentin, T. and A. Vandenberg (2003): Development of new and effective sources of ascochyta resistance in chickpea. [Poster Abstract] Pulse Days 2003, Saskatoon, January 6-7, 2003, p. 67

Chongo, G., Banniza, S., Gan, Y., Wolf, T. and T. Warkentin (2003): Fungicide application timing, sequencing, and tank mixes for controlling blight in chickpea. [Poster Abstract] Pulse Days 2003, Saskatoon, January 6-7, 2003, p. 84

Hashemi, P., Banniza, S., Davis, A., Warkentin, T. and A. Vandenberg (2003): Relationship between lodging, stem anatomy, and reaction to mycosphaerella blight in field pea. [Poster Abstract] Pulse Days 2003, Saskatoon, January 6-7, 2003, p. 64

Ford, R., Banniza, S., and P.W.J. Taylor (2002): Molecular characterization and diagnosis of anthracnose of lentil (*Colletotrichum truncatum*). Australian Plant Breeding Conference, Perth, Australia, September 16-20, 2002.

Extension Presentations

1. Disease issues in pulse crops in 2002. Variety Release Program Winter Meeting, Saskatoon, January 8, 2003.

2. Research in the pulse pathology program. Pulse Crop Information Meeting, Rosthern, January 22, 2003.

3. Research issues in pulse pathology. Pulse Information Meeting, Outlook, January 26, 2003.